Biocontrol Innovations

For a process so simple in nature—a seed germinates in the soil and grows into a fruitful plant—getting a healthy crop up and keeping it going can be an astonishingly complex task.

That's because crop plants have a multitude of enemies, seen and unseen. The most obvious enemies are the bugs—everything from borers that burrow into a plant's stem and wreak havoc from the inside out, to grasshoppers whose appetites have been known to extend to fenceposts and tractor tires.

Perhaps even more baffling are the "new" enemies—viral and fungal culprits that our farming ancestors could see only in terms of the devastation they left behind.

Of course, many of our new crop enemies aren't new at all. Potato farmers in recent years have been again battling *Phytophthora infestans*, the most destructive disease of potatoes worldwide. *P. infestans* is an ancient foe; it's the same fungus that repeatedly wiped out the Irish potato crop in the 18th and 19th centuries.

Sometimes the enemy changes just enough to confound control efforts—again, *P. infestans* comes to mind. Recently, a new, more virulent strain of late blight, the disease caused by *P. infestans*, has invaded the United States.

Agricultural Research Service scientists at Albany, California, are using the latest biotechnology to study a new experimental potato hybrid that might carry genes for resistance to the fungus. If the researchers can pinpoint and clone the gene behind the hybrid's disease resistance, they intend to transfer it to commercial potato varieties.

Cloning and moving genes are just a few pieces in the big picture of biocontrol—finding ways to protect plants other than with chemicals. Many times, nature provides a promising weapon in the form of natural enemies—from bacteria to wasps—that can do battle against insect pests, crop pathogens, and weeds, if only we can discover the most effective ways to use those weapons.

One of the most destructive crop pests ever to arrive in America is the silverleaf whitefly, *Bemisia argentifolii*, also known as biotype B of sweetpotato whitefly, *Bemisia tabaci*. This sap-sucking pest first appeared on poinsettias in Florida greenhouses in 1986. Within just 4 years, it had spread to dozens of crops in year-round farming regions of Florida, Texas, California, and Arizona. Losses caused by this tiny insect now run as high as $500 million per year.

Now a fungus called *Beauvaria bassiana* has proven highly effective at stopping the whiteflies. In tests in Weslaco, Texas, ARS scientists showed that *B. bassiana* killed up to 90 percent of the immature pests in small vegetable plots. Today *B. bassiana* is available commercially in a product called Mycotrol, the result of a cooperative research and development agreement between ARS and Mycotech Corp. of Butte, Montana.

In this issue, you'll read how ARS scientists across the country are pitting their ingenuity against crop pests. In North Carolina, the focus is on *Cercospora* fungus, which attacks a wide range of crops from corn to soybeans. ARS scientists have found that *Cercospora* carries around a vital internal defense—a gene that protects the fungus from its own poison. Those scientists are now pursuing whether that protective gene can be put to work in crop plants.

You'll also read about ARS researchers in California who've come up with one of the most unusual defensive maneuvers of all—actually flinging beneficial insects into fields aboard lightweight disks that degrade naturally in rain or irrigation water to unload their predacious passengers.

The battle to protect crops without chemicals has taken researchers down roads undreamed of only a few decades ago. One of the biggest challenges of pitting beneficial insects against crop pests has been producing great enough numbers of the beneficials.

Key to these efforts is a diet that will sustain and nourish beneficials, such as the *Edovum puttleri* parasitic wasps that attack Colorado potato beetles. ARS scientists in Colorado have cooked up an artificial diet that mimics the potato beetle eggs that are the favored snack of *Edovum* wasps and their offspring.

A special ingredient of that diet is hemolymph—insect blood. The ARS scientists are now searching for a cheap, off-the-shelf substitute for hemolymph, which harbors critical substances that trigger the wasp larvae's metamorphosis into adult insects.

If the scientists succeed, the benefits could be tremendous, both for farmers and the environment. In trials where 2,000 *Edovum* wasps were released weekly in eggplant fields, growers only had to spray chemicals 4 times during the growing season to combat potato beetles—down from the average 14 treatments.

"Chef to the bugs" was probably not on any ARS researcher's original list of career goals. But it's this kind of innovative approach to biocontrol-based crop protection that, in the long run, is going to ensure that all of us (and others around the world) have enough to eat.

Sandy Miller Hays
Director, ARS Information